

## **CLIMATE CHANGE: POST KYOTO SCENARIO ADAPTATIONS, POLICIES & CHALLENGES TO INDIA**

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### **ABSTRACT**

The increased awareness on the effects of climate change is now effervescent in all spheres of human activity and is reflected in the arduous debates from pro and against activists in achieving a consensus ideology to combat it, as it involves sacrifice of self and economic interests of various nations involved. Even though the climate change issue remains as one of the most discussed theme world over, consensus is evading as a solution satisfying the interests of all 'concerned parties' could not be finalized. On global emission reduction angle, voluntary principles approach has not been fully effective in achieving the results expected during the first commitment period. Mandatory action is opposed from western spheres, making the ground for fair play bleak in achieving the expected outcomes in reduction of emissions. The conflicts of interests between environmental activism and industrial growth paradigms for the developed and developing world aren't resolved. Even though a global consensus is still under discussion, the regional importance attached to the issue of climate change in all corners of the world and the actions being initiated at national levels are a real achievement. Considering the increasing level of GHGs in the atmosphere and the delay between emissions and its impact on climate, likelihood are quite high that more warming is inevitable. IPCC Working Group II suggests that mitigation and adaptation should be complementary components of a response strategy to global warming. This paper traces the future implications, challenges and trends in areas of climate change concerns for India as it is gearing up its manufacturing sector growth by the "Made in India" blitz in post Kyoto 2013 era.

**KEYWORDS:** Climate Change, Kyoto Protocol, CDM, Mitigation, Adaptation

### **INTRODUCTION**

Year after year we find an increase in the warmth of the climate and the theory of global warming is accepted by the majority worldwide. A recent study of an ice core from the Naimona'nyi glacier in the southwestern Himalayas (Kehrwald et al., 2008) shows that ice is disappearing from the top of the glacier at a considerable rate. If, as predicted, global temperature rises by another 3<sup>0</sup>C (5.4<sup>0</sup>F) by the end of the century, the earth will be warmer than it has been at about 3 million years back (Dowsett et al., 1994; Rahmstorf, 2007).

Of the land ice on the planet, 96% is found on Greenland and Antarctica, which could lead to considerable sea level rise by its melting in the warming world (Church et al., 2001; Lemke et al., 2007). The 4<sup>th</sup> IPCC report predict a sea level rise in the range of 28 cm to 98 cm under different projection scenarios by the year 2100 mainly due melting of ice and thermal expansion of oceans. The inescapable conclusion from different scientific studies is that the rise in temperature is mainly due to anthropogenic forces, that is, human behavior. The choice of prevention was lost as an option by mankind

in dealing with climate change primarily due to imbalanced and fast paced industrial growth. But still mitigation and adaptation options to deal with new scenario hold promise for slowing down the pace and magnitude of the anthropogenic climate change phenomena by altering the underlying causes.

## **CLIMATE CHANGE, IPCC & UNFCCC**

The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988 to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. Countries came together in 1992 at the Earth Summit in Rio to consider what they could do to limit global temperature increases and the resulting climate change and to cope with its impacts by joining an international treaty - the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC was opened for signature along with its sister Rio Conventions, the UN Convention on Biological Diversity and the UN Convention to Combat Desertification. The negotiations under UNFCCC to strengthen the global response to climate change which finally in 1997, ended up by adoption of the Kyoto Protocol.

## **THE KYOTO PROTOCOL**

The Kyoto Protocol is an international agreement linked to the UNFCCC, which commits its Parties by setting internationally binding emission reduction targets. The protocol recognizes that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity. Hence the Protocol under the principle of "common but differentiated responsibilities" places a heavier burden on developed nations. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The Protocol's first commitment period started in 2008 and ended in 2012. There are now 195 Parties to the Convention and 192 Parties to the Kyoto Protocol. As a follow up action plan, a second commitment period is planned for the period upto 2020.

Kyoto Protocol is considered as the first practical step towards a truly global emission reduction regime for stabilizing the GHG emissions and is expected to provide the architecture for the future international agreement on climate change. In the Kyoto Protocol the signatory countries should meet their targets primarily by national measures taken but the protocol also offers an additional means to meet the country targets by way of three market based flexible mechanisms.

- Clean Development Mechanism (CDM)
- International Emissions Trading
- Joint implementation (JI)

## **CLEAN DEVELOPMENT MECHANISM (CDM)**

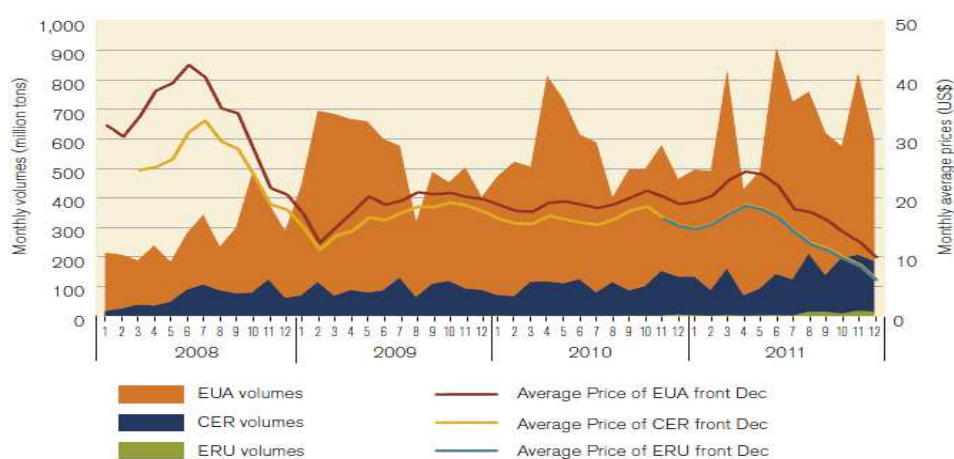
Under the CDM, an industrialized country (Annex-1) having a binding emission reduction target, with technology for reduction of emissions of Green house gases can invest in projects which reduce GHG emissions and contribute to the sustainable development in Non-Annex I countries, can claim credit for the reduction in emission that the project achieves. Annex I country receives Certified Emission Reductions (CER) and Non-Annex I country receives revenues from CERs (one CER refers to one Ton of CO<sub>2</sub> equivalent avoided in a CDM project - CDM Rule Book). Greenhouse gases (GHG)

considered under CDM include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride etc. GHGs are having different warming potential and it is conventional to express all gas emissions in “equivalent amounts of carbon dioxide” (CO<sub>2</sub>e). (Report of the working group - CDM in India, 2003)

The main objectives of CDM are to help Annex 1 countries meet their emission reduction objectives in a cost-effective way and contribute to sustainable development of the host country. The Govt. of India responded to the Kyoto protocol in August 2002 and the eighth Conference of Parties (COP8) was hosted by India in Nov-Dec’02. National CDM Authority was established in December ’03 and the First CDM project from India was registered in March ’05. CDM has helped the Indian Industry in bringing awareness on the potential for GHG emission reduction and has opened an array of opportunities for India industry in mitigating GHG emission with a special focus to energy efficiency and renewable energy and cleaner technologies

### CDM PERFORMANCE DURING FIRST COMMITMENT PERIOD

During the first commitment period 93 countries host at least one registered CDM project. As on 31-12-2012 a total of 7167 CDM projects had been registered and in this group China and India are the clear leaders with a share of 70% of registered projects. Out of the total issuance of 1.36 billion CERs China and India share 74% of issuance volume. (data from the UN Environment Programme Risoe Centre, 2014), making the geographic distribution of CDM projects by host country and region uneven, both in terms of the number of projects and the volume of credits. Considering the project type, HFC and N<sub>2</sub>O abatement projects were found more fruitful during the first commitment period mainly on account of their higher warming potential.



Source: World Bank

**Figure 1: Prices and Volumes for EUAs, CERs and ERUs in the s Secondary Market, 2008-2001**

Special consideration was given to Least Developed Countries (LDC) and Small Island Developing States (SIDs) by exempting them from registration fee and fee to the adaptation fund. Also during COP-15 at Copenhagen, CDM rules were made simpler for the LDCs and SIDs for demonstration of CDM additionality. Eventhough CDM has been effective in mobilizing mitigation projects in developing countries, it has been criticized for weak environmental integrity, high transaction costs and complex governance (Michaelowa; 2012). The report by the high-level panel on the CDM policy dialogue July 2012 ([http:// www.Cdmpolicydialogue.org/research/103\\_impact. pdf](http://www.Cdmpolicydialogue.org/research/103_impact.pdf)) confirms that large-scale power

supply and methane projects are unlikely to be additional. This can be one of reasons disturbing the economic effectiveness of the CDM by way of oversupply of CERs that do not represent genuine emission reductions.

## **POST KYOTO SCENARIO**

With the completion of the first commitment period and uncertainties regarding the follow up plan, CDM market is unsteady at present and the market prices of Certified Emission Reductions (CER) are at rock bottom. Ban on HFC-23 and Nitrous Oxide by European Union also affected the CDM market in post 2012 scenario. HFC-23 is a byproduct of the manufacture of HCFC-22, one of the most commonly used refrigerant. Due to the high warming potential, CDM projects involving destruction of HFC-23 attracted large amount of credits (CERs) during the first commitment period and indirectly led to increased production of HCFC-22. Considering these factors, EU has banned HFC-23 credits from use in their European Emissions Trading System (EU-ETS) from April 2013. Similar is the case of Nitrous oxide (N<sub>2</sub>O) from adipic acid used in the manufacture of nylon. During the first commitment period, around 37 industrialized countries and the European Community committed to reduce GHG emissions to an average of five percent against 1990 levels. During the second commitment period of the protocol, the parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period from 2013 to 2020, however, the composition of Parties in the second commitment period is different from the first. ([http:// unfccc.int/ Kyoto-protocol /items /2830txt.php](http://unfccc.int/Kyoto-protocol/items/2830txt.php))

## **THE PREDICAMENT IN THE CLIMATE CHANGE MEET TALKS**

Movements to bring more accountability on the emerging countries with Luke warm Institutional accountability from maximum GHG emitting countries has induced certain alienations that weakened the cohesiveness of the world to reach a consensus on climate change. The reason for the collapse in CER prices is two-fold: first, low demand due to very weak emission reduction targets and second over-supply of carbon credits mainly due to soft rules in certain areas of CDM. Here both the lack of demand due to insufficient ambition and the over-supply have to be addressed. Also the non support from the maximum GHG emitting country 'US' in the move also has affected the overall effectiveness of the scheme. In the Lima Conference 2014 at Peru too, critical measures like review and external monitoring of intended Nationally Determined Contributions (INDCs) were not given sufficient focus.

Even though the climate change conferences during the last few years took steps forward by agreeing on a second commitment period under the Kyoto Protocol and procedures for negotiating a new global agreement, no global consensus has reached so-far. Doha climate conference in 2012 took a number of small steps forward by agreeing on procedural guidelines for negotiating a new global agreement by 2015. More than 85 developing and developed countries have made pledges to reduce their emissions. But considering the fact that the world energy consumption has been always on the rise during the past decades and the delay between emissions and its impact on climate, even if all these pledges are fulfilled, likelihood are quite high that more warming is inevitable.

IPCC Working Group II discusses that mitigation and adaptation should be complementary components of a response strategy to global warming. Earlier mitigation was given more focus but now here adaptation is equally important at all scales to complement climate change mitigation efforts as we are still not sure about the exact effects of GHG mitigation on warming on a time scale.

Affirmative actions from major GHG emitters can spur motivation for new developing economies to follow the track to manage climate change risks. This has to be demonstrated by high propensity in emission reporting mechanisms by

all countries. As there exists strong new collaborations across the new supply chains to the world that emancipate from China & India due to the good financial returns, mutually beneficial & sustainable opportunities for emission reduction initiatives needs to be chalked out, beyond the regulatory ambit of trade initiatives. With the effective utilization of education, technology, infrastructure, management capabilities and resources, humans are considered to be capable of adapting to the changes, minimising adverse impacts while converting the challenges to new opportunities.

## CLIMATE CHANGE PARADIGMS - THE REAL ISSUES

IPCC project the impacts of climate change over ecosystems, economy and the populations all over the world. The impact of past and present GHG emissions to the climate systems are expected to continue for a long time, implying that even if worldwide emissions are stabilized and reduced, it will take a longer period to show its positive effects on climate change. Studies suggest that at the current level of progress world that is looking less and less likely to stay within 2 °C of global warming (e.g., World Bank, 2012). This calls for a need to focus on more specific policies and time bound action plans based on scientific principles focusing mitigation and adaptation.

## CLIMATE CHANGE - ADAPTATION & MITIGATION STRATEGIES

The basic concept is to prioritize adaptation efforts in communities where vulnerabilities are highest and where the need for safety and resilience is greatest. National Adaptation Programs of Actions (NAPA) are planned specifically for the least developing countries. From the present projections, it is anticipated that by 2020, developing countries also are expected to contribute to the global mitigation efforts. This can have an impact on the original purpose of the CDM as the developing countries may have to account for their own emission reductions. Newer mechanisms may have to be developed for financing emission reductions in developing countries.

Adaptation to the changing scenario needs special attention on Changes in behavior (e.g. in water use or farming practices), Technological responses (greening), Structural changes (e.g. in the design spec of bridges and roads), Policy based responses (e.g. integrating risk management and adaptation into development policy), Improved forest management and biodiversity conservation etc.

**Table 1: Adaptation & Mitigation Options**

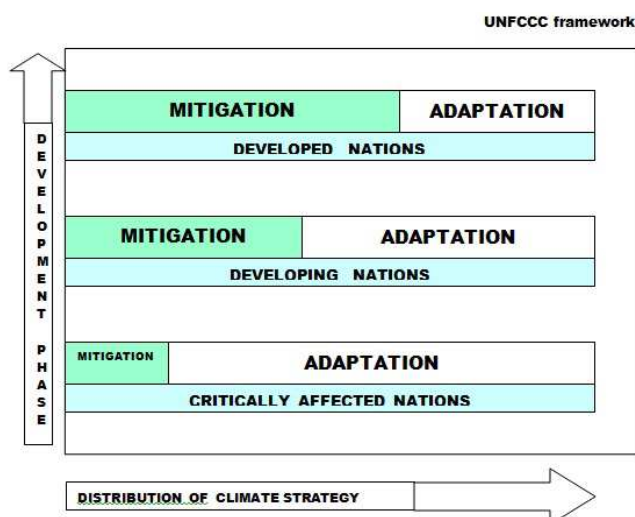
<b>Adaptation Options (Reducing Vulnerability)</b>	<b>Mitigation Options (Reducing Emissions)</b>
Planning for rising sea levels	Kyoto Protocol
Sustainable land use planning, Water harvesting, Waste management	LULUCF (Land Use, Land-Use Change and Forestry)
NAPAs (National Adaptation Programs of Actions) limited to the least developing countries	NAMA (Nationally Appropriate Mitigation Actions)
Integrating risk management and adaptation into development policy	REDD (Reducing Emissions from Deforestation and forest Degradation)

Mitigation strategies focus on Renewable energy technologies (RETs) & Energy efficiency improvement measures with special attention in Transport & the aviation sector, Green buildings, R&D for the development of climate-friendly technologies, focus on water use efficiencies, better and more suitable agriculture and afforestation etc. Developing countries are encouraged to craft Nationally Appropriate Mitigation Actions (NAMAs) in line with their national development objectives. NAMAs are plans of developing countries to reduce emissions and to develop sustainably which can be supported by developed countries. The UNFCCC secretariat has established a registry to match requests for

and offers of support.

## LOCAL / NATIONAL / REGIONAL FOCUS

In the post 2012 scenario, there is an increasing number of governments (local, national and regional) intend to utilize market-based policies to address greenhouse gas emissions. In addition to the established emissions trading systems in Europe, New Zealand, and regions in the United States of America, systems are emerging in Australia, Canada, China, Kazakhstan and South Korea. Crediting programmes are also emerging, including bilateral mechanisms between developed and developing countries as well as a range of offset protocols.



**Figure 2: Climate Strategy for Countries at Different Development Phase**

At Local level, land use and municipal planning represent important avenues for adaptation to global warming. Water harvesting, Waste management and Planning for rising sea levels are the key challenges for local planning in response to climate change.

## NEW CDM CANVAS

CDM rules have served and are expected to serve as a blueprint for other carbon market mechanisms. As CDM is used as a reference by many other emerging schemes, more focus should be given in refining its rules further to confirm environmental integrity of participating countries.

Areas for improvement

- Considering the shortening of technological life cycle, length of crediting period may be reviewed for effective additionality.
- Addressing the conflicts of interest of DOEs from the point of view of business relationships with project developers compromising the auditors' independence and neutrality.
- More effectiveness in promoting investments in non-fossil energy sources

## NEW INITIATIVES OF UNFCCC

- UNFCCC offers support to the National Action Plans of member countries by giving more visibility through

UNFCCC website which can improve the opportunity for receiving backing.

- The UNFCCC secretariat's Momentum for Change Initiative presented "Lighthouse Activities," awards to some of the best examples of climate solutions in the world for motivating climate action. During 2014, winners, or "Lighthouse Activities," range from a Latin American microfinance initiative for supporting the resources for climate action across the region and for the solar energy boom in Thailand.
- The green light was given for discussions with the Green Climate Fund (GCF) on how countries can be supported with their NAPs.
- Launching of Multilateral Assessment (MA) at LIMA Conference based on the decisions taken at previous COPs, with an aim of Providing more transparency of developed country action, in which about 17 developed countries with quantified economy-wide emission reduction targets were assessed by other governments or 'Parties' to the Convention.

## WAY FORWARD

The new Market Mechanisms for the second commitment period can use the governance structure of the CDM with baseline and monitoring methodologies focusing more on sustainable development.

- More focus on ethics and responsibilities
- Rethink on the concept of global warming potential based CDM credits.
- More focus on effective strategies and measures
- Focus on regional treaties (collaboration between willing countries) & local initiatives to implement GHG emission reduction measures
- Promote green technologies & policy frameworks for their deployment

## THE INDIAN SCENARIO

India faces now a unique dilemma in development which previous countries didn't face (those utilised energy irrespective of the green quotient of energy sources). The main Indian challenge in this planned industrial growth scenario is to find a tradeoff between development and reducing energy intensity. To achieve sustainable development path that simultaneously advance economic and environmental objectives, India has already developed a National Action Plan for Climate Change (NAPCC) envisaging countries efforts being led through 8 missions, two of which focus on mitigation and six on adaptation. The two key areas that focus explicitly on climate change mitigation are solar energy (National Solar Mission) and energy efficiency improvement (National Mission for Enhanced Energy efficiency) with targets of 20000 MW power generation/ saving by the year 2020. Under the Energy efficiency scheme, Perform Achieve and Trade (PAT) scheme is being implemented focusing energy intensive industries. Renewable Energy Certification is another area aiming renewable Energy options for industries where renewable energy generation/ usage targets are planned for industries.

NAPCC missions focusing climate change adaptation are

- National mission on sustainable habitat
- National water mission

- National mission for sustaining the Himalayan ecosystem
- National mission for a green India
- National Mission for sustainable agriculture
- National mission on strategic knowledge for climate change

These missions are institutionalized by respective ministries and organized through inter-sectoral groups including respective ministries, planning commission, experts from industry, academy and civil society. For future Indian investments to focus on what, whom and why for mitigating climate change needs very clever selections as the conventional thoughts and knowledge in the Indian framework may not be sufficient in choosing the correct strategy as India is far more vulnerable to global warming than most of the developed countries.

Considering the new Government policy on “Make in India” as a part of India’s development plans, a fresh focus is imminent on Manufacturing sector. This scenario necessitate augmented dependence on fossil fuels in future. Earlier developments were not much concerned about carbon emissions but now India has a novel challenge in making it prepare for a Low carbon Growth-planning and multilateral actions to reduce carbon emissions. Sustained growth & poverty elimination along with low environmental carbon foot print would compel India to evolve and lead a “low carbon inclusive growth model” by adopting and practicing befitting renewable energy friendly alternatives.

Energy efficient urbanization and industrialization only can lead to modernization of India in a green and clean way. Resources, supports from climate fund, green carbon fund, international development fund etc also needs to guide the investments towards this goal. It is a fact that most green technology for climate change mitigation approaches are in the developed world. Development financial aid and concessional energy transfer deals with developed countries needs to be worked out as part of global climate change adaptation and mitigation plans to bring a real change.

For a Low carbon Growth-planning, the country needs to focus more in energy efficiency, waste management, renewable energy initiatives, regulatory measures and mapping of carbon intensity. Suggested areas of focus for India in this regard are:

- Indian GDP growth should have a green index for growth by promotion of clean & green, urbanization and industrialization.
- All technology transfer to India in various sectors should be rated in terms of green assessment audit in future.
- Emission reduction initiatives in all value chain addition should be incorporated in the development scheme.
- Institutions from national to village (panchayat) levels should have climate change initiatives and specific plans with fund allocation.
- Carbon footprint of all states starting from the panchayat level mapping and reduction plans as a part of policy would usher in change in thought process and framing of policy and project initiatives
- State wise and national level audit of carbon emissions needs to be mapped with targeted reduction aims along with green funds.
- Regulatory city planning measures for reducing carbon foot-print in transportation sector with special focus on



mass transport system development and energy efficient vehicles.

- Clean & green building techniques and energy efficient urbanization should be focused and implemented
- Emissions mapping & reporting guidelines to be made statutory to get the correct trajectory of low carbon growth mission.
- National planning in sectors of fertilizer, food, oil etc to make it more green with well spread growth of production & distribution infrastructure all over country.
- Awareness at educational levels needs to be inculcated regarding climate change. Solar lighting and power for schools and colleges etc would infuse the idea of clean and green energy sources for the citizens of tomorrow. Curriculum development for climate change at educational levels, green policy framework at local administration levels etc need to be statutorily imposed for making a difference in India's growth trajectory.
- Implementing of cooking gas grids in cities (city gas) and rural areas can bring in change to emission quotient of cities and villages.
- Decentralised waste management plans covering aerobic and anaerobic options for the public
- Monetary benefits, tax reductions and subsidies for green development need to be embedded in the planning framework for reducing carbon intensity of growth. Subsidies to be specified with economic assessment of the green initiatives taken in production and distribution in all sectors.
- "Make in India" is a self sufficiency concept but to transform it to "Made at India" tag would bring meaningful change in industry efficiency. For this, India need to focus beyond import substitution to a hub by efficiency where it turns out products for the world.

## CONCLUSIONS

As per the study by Japan Meteorological society, 2014 was the hottest year recorded so-far. Scientific community believes that with the effective utilization of education, technology, infrastructure, management capabilities and resources, humans are considered to be capable of handling Climate change challenge in technical and economic terms, but seem unable to handle it well in social and political terms as most of the political decisions are not taken based on scientific & technical perspectives. Global climate negotiations could not converge in to a solution, appropriate to satisfy the concerns of the developed nations and the aspirations of the developing world in formulating an action plan to avert the climate change in a sustainable way. Even though a global consensus is still wanting, the regional importance attached to the issue of climate change in all corners of the world and the actions being initiated at national/regional levels in different parts of the world are a real achievement. As the world seems heading for a future with more than 2<sup>0</sup>C warming, special consideration should be given for mitigation and adaptation sectors linking social and natural systems.

Indian challenge in this planned industrial growth scenario is to find a tradeoff between development, urbanization and reducing energy intensity. To achieve a sustainable development path that simultaneously advance economic and environmental objectives, India need to insist on institutional accountability at all levels along with the technological changes in energy sectors. Reforms are now inevitable in the Indian growth story but basic principle guiding reforms must be to create a low carbon intensity growth with a stress on efficiency for sustained development. All the

developmental projects require attention at the micro as well as the policy levels for inducing a green growth. Improving productivity of capital and energy efficient growth will have the social impacts for development, as sustained green growth is the answer to manage the climate change risks.

## REFERENCES

1. Axel Michaelowa (2012), Strengths and weaknesses of the CDM in comparison with new and emerging market mechanisms, Paper No. 2 , the CDM Policy Dialogue.
2. Church, J. A., Gregory, J. M., Huybrechts, P., Kuhn, M., Lambeck, K., Nhuan, M. T., et al. (2001). Changes in sea level. In *Climate change 2001. The scientific basis. Contributions of Working Group I to the 3<sup>rd</sup> assessment of the IPCC*. Cambridge, UK: Cambridge University Press.
3. Doha decisions (2012). <http://unfccc.int/resource/docs/2012/cmp8/eng/13a01.pdf>
4. Dowsett, H. J., Thompson, R., Barron, J., Cronin, T., Fleming, F., Ishman, S., et al. (1994). Joint investigations of the middle Pleistocene climate 1: PRISM paleoenvironmental reconstructions. *Global and Planetary Change*, 9, 169–195.
5. International Energy Agency & Organisation for Economic Cooperation and Development 2007.
6. IPCC (2001), ‘Climate Change 2001: Mitigation’, Working Group III, Third Assessment Report, Section 1.3.1, Cambridge University Press, Cambridge.
7. IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22.
8. IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
9. Kehrwald, N. M., Thompson, L. G., Yao, T., Mosley-Thompson, E., Schotterer, U., Alfimov, V., et al. (2008). Mass loss on Himalayan glacier endangers water resources. *Geophysical Research Letters*, 35, L22503.
10. Pelling, M., & Satterthwaite, D., 2007. Investigating urban risk accumulation in six countries in Africa. African Urban Risk Analysis Network.
11. Rahmstorf, S. (2007). A semi-empirical approach to projecting future sea-level rise. *Science*, 315, 368–370.
12. Springer U. (2002), ‘The market for tradable GHG permits under the Kyoto Protocol: a survey of model studies’, *Energy Economics*, 25 (5) , 527-551.
13. Stern, N., 2006. *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge, UK.
14. UNFCCC (1992), ‘United Nations Framework Convention on Climate Change’, New York, 9May 1992, in force

21 March 1994, 31 ILM 849.

15. UNFCCC, 2007. Synthesis of outcomes of the regional workshops and expert meeting on adaptation under decision 1/cp.10. Subsidiary body for implementation twenty-sixth session, Bonn, 7–18 May 2007
16. World Economic and Social Survey (2009): Promoting Development, Saving the Planet (PDF), New York, USA: United Nations, p. 162, ISBN 978-92-1-109159-5
17. IPCC – Intergovernmental Panel on Climate Change (2014). *Working group III. Mitigation of Climate Change*. <http://mitigation2014.org/report/final-draft/>

